



**Spring is here, and it's not just the flowers that are growing!** TA is adding staff in all departments and offices to better serve our expanding clientele. As we begin Year 8, we look forward to pushing the envelope on cutting edge design and continuing to expand, both in personnel and scope of services we offer. A big thank you to everyone who has helped us make our first seven years such a success!

## Environmental Acoustics

### Is It Noise Or Is It Sound?

How loud is too loud? If you have ever dealt with this question, personally or professionally, you know that answer is difficult to determine. All kinds of factors, from the time of day to personal sensitivity, influence the subjective cry "Too much noise!" In fact, the term noise is used to indicate any sound that is unwanted. And what to one person is music may be harsh and unwanted noise to another. Just ask the parent of any teenager! In this article we will unravel some of the mystery surrounding environmental acoustics. What contributes to this issue? What are the terms and concepts used to discuss it?

#### The Building Blocks

Most likely you have heard the term decibel, but perhaps  $L_{EQ}$ , dBA, or Ldn are less familiar. Many terms have been created in an attempt to help set some guidelines for discussion of environmental sound.

To understand the subjective response to sound, we have to understand three basic aspects of sound: *level*, *frequency content*, and *time varying characteristics*.

The first term, *level*, is the first one that many people think of when describing a sound. It is a measure of intensity or loudness, generally expressed as decibels (dB). Check out the diagram at right to see a comparison of common sound levels.

Another way people speak of a sound is "high and whining", or "low and rumbly". This refers to the pitch, or *frequency*. Frequency is expressed in Hertz (Hz).

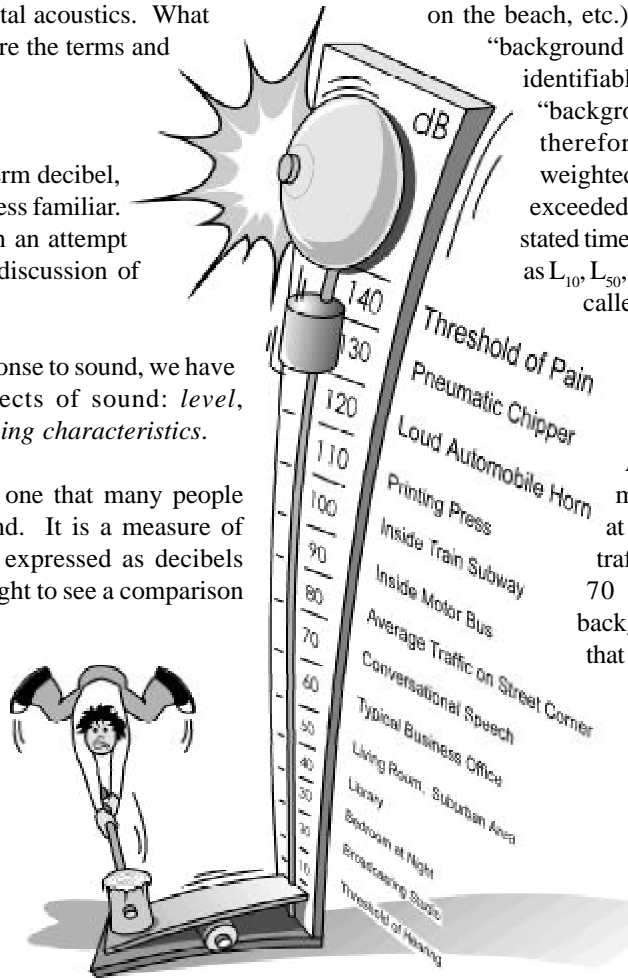
Because the human ear perceives extremely low and high frequency sounds as less annoying than mid frequency sounds, different weighting scales have been developed. Environmental measurements are commonly made using the "A-weighting" scale. This scale represents the subjective "noisiness" of a sound and more closely corresponds to the sensitivity of human hearing. Sound levels measured with an A-weighted scale are referenced as "dBA". The drawing below uses A-weighted sound levels.

Although the A-weighted noise level may adequately indicate the level of environmental noise at any instant in time, community noise levels vary continuously. This leads us to the third characteristic, *time varying characteristics*. Basically, this characteristic looks at how the sound levels change over time and how sensitive humans are to those changes. Most environmental noise includes a combination of noises from

distant sources (traffic, wind in the trees, waves crashing on the beach, etc.) These create a relatively steady "background noise" in which no one source is identifiable. The amount of noise above the "background noise" will vary over time, therefore it is helpful to know the A-weighted noise level that was statistically exceeded during 10%, 50%, and 90% of a stated time period. These levels are referenced as  $L_{10}$ ,  $L_{50}$ , and  $L_{90}$ . A single number descriptor called the  $L_{EQ}$  is also widely used. The  $L_{EQ}$  is the average A-weighted noise level during a stated period of time.

Adding another element into this mix is the fact that noises tolerable at 3 pm are unbearable at 11 pm. Light traffic on a nearby street may only be 70 dB, but at night, the exterior background noises are so much lower that the same amount of traffic becomes noticeable. To account for this human sensitivity to nighttime noise levels, a descriptor, Ldn (day/night average sound level), was developed. The Ldn divides the 24 hour day into the daytime hours (7am - 10pm) and nighttime hours (10pm - 7am). The nighttime noise levels are "penalized" or weighted 10 dB

higher than the daytime noise levels (thus a sound that would be weighted at 40 dB during the day is given a rating of 50 dB at night. Another 24-hour average sound level, the Community Noise Equivalent Level (CNEL) is also used and includes both an evening (5 dB Penalty) and nighttime weighting (10 dB Penalty).



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**Now What?**

Now that we've discussed the basic terms used to talk about environmental acoustics, we can go on to the heart of the issue: Why do we care about environmental noise? We care because what we hear affects us, often without our realizing it. If we are unhappy with a space, it may be because of too much noise. The effects of noise on people fall into three general categories:

- ♦ subjective effects of annoyance or nuisance
- ♦ interference with activities such as speech, sleep, and learning
- ♦ physiological effects such as startling or hearing loss

The levels associated with environmental noise, in almost every case, produce effects only in the first two categories. Workers in industrial plants, airports, or race tracks can experience noise in the last category.

The wide variation in individual thresholds of annoyance and a person's ability to adapt to existing noise means that there is no satisfactory way to measure the subjective effects of noise, or of the corresponding reactions of annoyance and dissatisfaction. Therefore, an important way of determining a person's subjective reaction to a new noise is to compare it to the existing environment — the so-called "ambient" noise level.

In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be judged by those hearing it.

Here are some interesting facts that help put all of this into perspective.

- ♦ Except in carefully controlled laboratory experiments, a change of 1 dB cannot be perceived.
- ♦ Outside of the laboratory, a 3 dB change is considered a just-perceivable difference.
- ♦ A change in level of at least 5 dB is required before any noticeable change in community response would be expected.
- ♦ A 10 dB change is subjectively heard as approximately a doubling in loudness, and would almost certainly cause an adverse change in community response.

We hope this has helped clarify some of the issues surrounding environmental acoustics. Stay tuned for our summer issue, when we discuss High Definition Television (HDTV). And don't forget, this newsletter, and all our other newsletters are available at [www.TA-Inc.com](http://www.TA-Inc.com)!

**Attention Architects, Facility Managers, Designers, and Specifiers! Increase your knowledge of acoustics and presentation system requirements to better serve your clients.**

Day 1 is *Essentials of Acoustics: Theory and Hands-On Applications*, a workshop devoted to clarifying terminology and defining terms readily used for the description of acoustics within a room.

Day 2 is *Presentation Facility Design and Audiovisual Considerations*, which outlines major issues to be considered in the design and integration of a new Presentation Facility.

Look for detailed information and class registration on our website, [www.TA-Inc.com/aia](http://www.TA-Inc.com/aia). Current scheduled dates and locations include:

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|---------------------|----------------------|
| <b>April 14-15</b>  | <b>Chicago</b>       |
| <b>June 23-24</b>   | <b>Orlando</b>       |
| <b>July 21-22</b>   | <b>Seattle</b>       |
| <b>October 6-7</b>  | <b>Denver</b>        |
| <b>November 3-4</b> | <b>Dallas</b>        |
| <b>Winter 2001</b>  | <b>San Francisco</b> |